

Appl. No. 10/711,015

Amdt. dated February 14, 2006

Reply to Office action of November 16, 2005

**Amendments to the Claims:**

1. (Currently amended) A copper damascene process, comprising:
  - forming a dielectric layer overlying a substrate;
  - etching a damascene opening into said dielectric layer;
  - 5 filling said damascene opening with copper or copper alloy;
  - treating a surface of said copper or copper alloy with hydrogen-containing plasma;
  - reacting said treated surface of said copper or copper alloy ~~with trimethylsilane or~~  
~~tertramethylsilane~~—under plasma enhanced chemical vapor deposition (PECVD)
  - conditions comprising simultaneously supplying trimethylsilane or tertramethylsilane and
  - 10 initiating plasma to make said trimethylsilane or tertramethylsilane react with said treated  
surface of said copper or copper alloy; and
  - in-situ depositing, by PECVD, a silicon carbide layer capping on said copper or  
copper alloy.
- 15 2. (Original) The copper damascene process according to claim 1 further comprising:
  - lining said damascene opening with a diffusion barrier layer;
  - forming a seed layer on said diffusion barrier layer; and
  - forming said copper or copper alloy on said seed layer.
- 20 3. (Original) The copper damascene process according to claim 1 wherein said  
damascene opening comprises a contact or via hole in communication with a trench  
opening.
4. (Original) The copper damascene process according to claim 1 wherein the step of  
25 reacting said treated surface of said copper or copper alloy with trimethylsilane or  
tertramethylsilane comprises following processing parameters: a trimethylsilane (or  
tertramethylsilane) gas flow in the range of 100 to 5000 sccm; a process temperature in  
the range of 300°C to 450°C; and a reaction duration in the range of 0.1 seconds to 30

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seconds.

5. (Currently amended) A copper damascene process, comprising:
- forming a dielectric layer overlying a substrate;
  - 5 etching a damascene opening into said dielectric layer;
  - filling said damascene opening with copper or copper alloy;
  - treating a surface of said copper or copper alloy with hydrogen-containing plasma;
  - reacting said treated surface of said copper or copper alloy ~~with trimethylsilane or~~  
~~tertramethylsilane~~—under plasma enhanced chemical vapor deposition (PECVD)
  - 10 conditions comprising simultaneously supplying trimethylsilane or tertramethylsilane and  
initiating plasma to make said trimethylsilane or tertramethylsilane react with said treated  
surface of said copper or copper alloy; and
  - in-situ depositing, by PECVD, a silicon carbide layer capping on said copper or  
copper alloy, said silicon carbide layer being treated with in-situ ammonia plasma to
  - 15 remove contained oxygen of the deposited layer.
6. (Original) The copper damascene process according to claim 5 further comprising:
- lining said damascene opening with a diffusion barrier layer;
  - forming a seed layer on said diffusion barrier layer; and
  - 20 forming said copper or copper alloy on said seed layer.
7. (Original) The copper damascene process according to claim 5 wherein said  
damascene opening comprises a contact or via hole in communication with a trench  
opening.
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8. (Original) The copper damascene process according to claim 5 wherein the step of  
reacting said treated surface of said copper or copper alloy with trimethylsilane or  
tertramethylsilane comprises following processing parameters: a trimethylsilane (or

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tertramethylsilane) gas flow in the range of 100 to 5000 sccm; a process temperature in the range of 300°C to 450°C; and a reaction duration in the range of 0.1 seconds to 30 seconds.

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